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(54) Drive Belt

(57) A drive belt (1) comprises a flat annular body (4) of elastomeric or other material which is reinforced internally (a) by flexible continuous elongate elements (9) which are tension-resistant and which extend longitudinally of the belt and (b) by layers (10, 11) of reinforcing elements (12, 13) which extend parallel to one another in each layer, the elements in said layers extending in respective directions which cross symmetrically with respect to the median line of the belt.

Openings (which may be through-openings) are provided in the body. The openings (6) may be arranged in a row or in parallel rows between which there is a zone containing longitudinally extending reinforcements.

Other layers, of elongate elements extending transversely of the belt, may be provided, and also anti-abrasive covering layer(s).

The pulleys have radially projecting protuberances (teeth) for engagement of said openings.

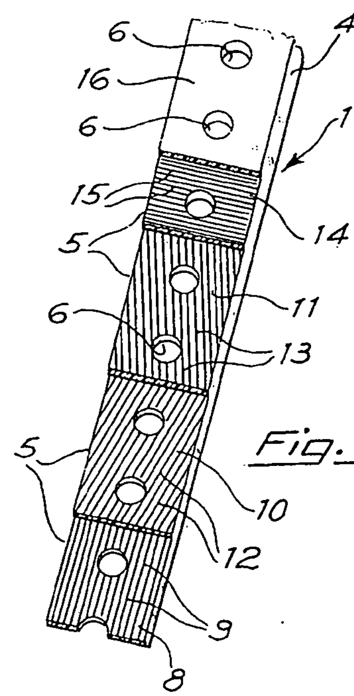

Fig. 2

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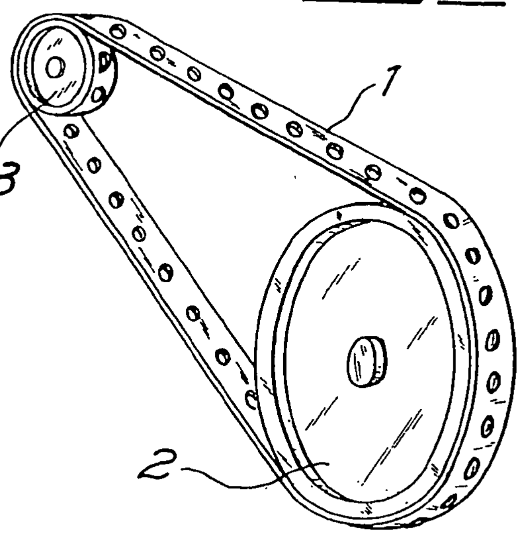
Fig. 1



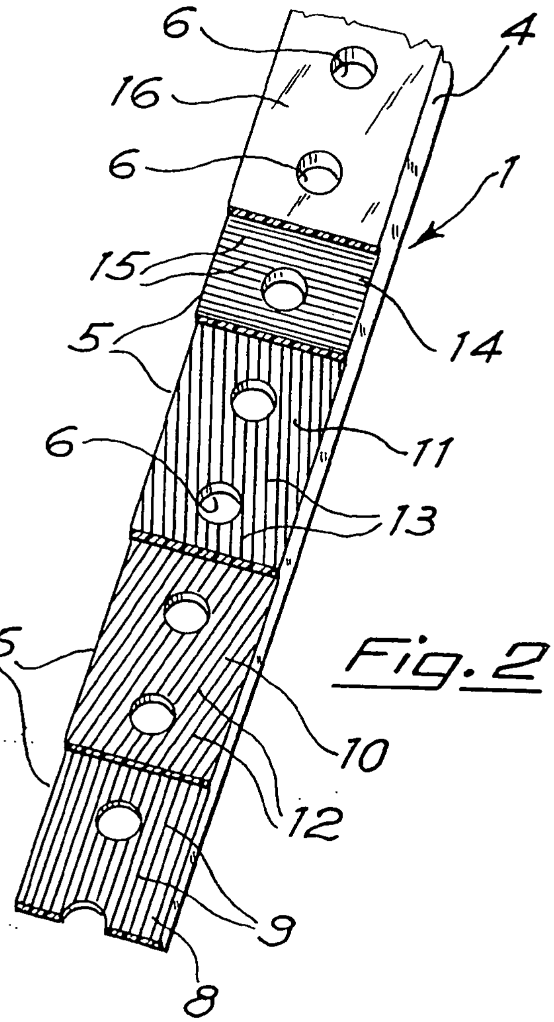


Fig. 2

Fig. 3

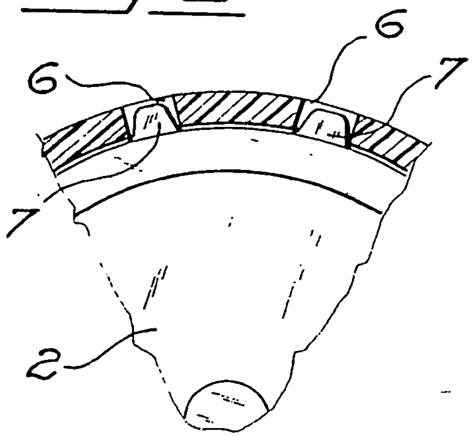


Fig. 4

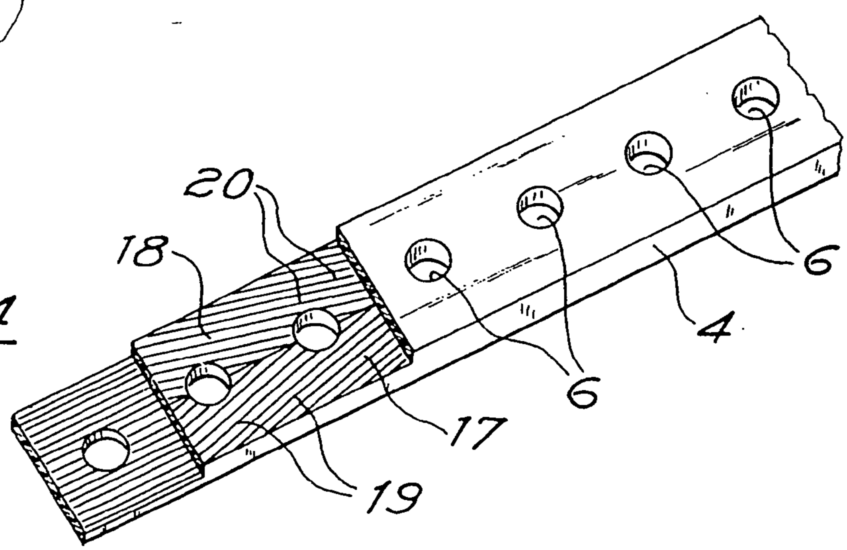


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Fig. 5

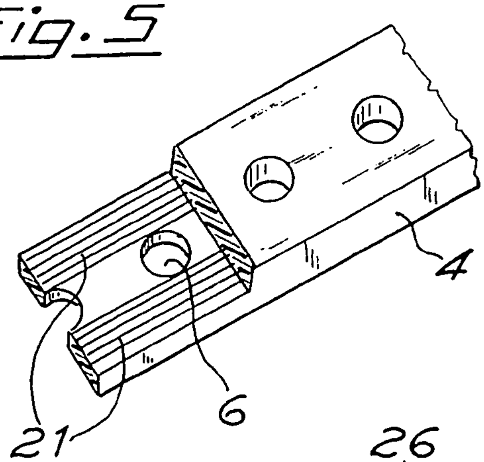


Fig. 6

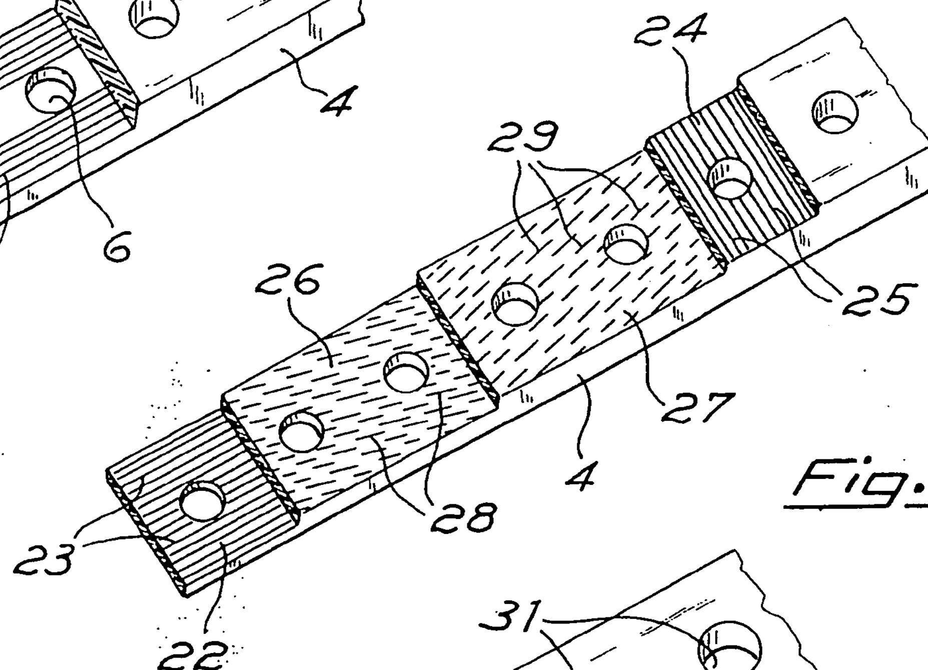


Fig. 7

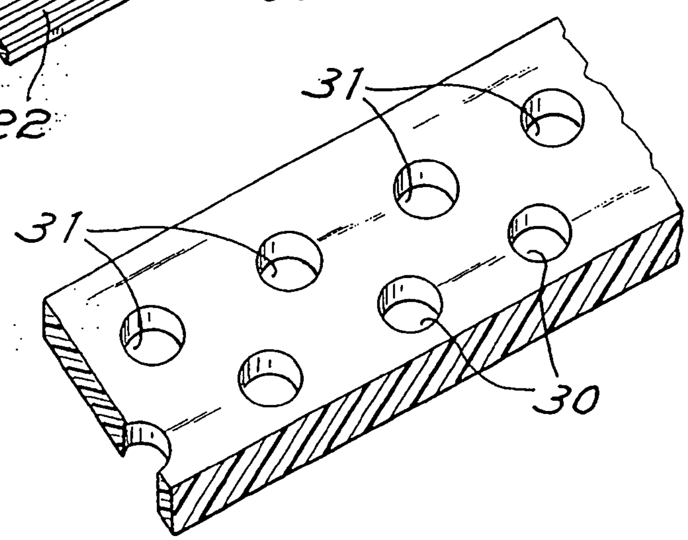
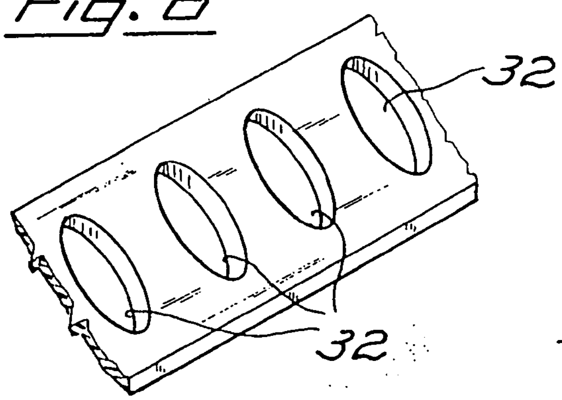


Fig. 8



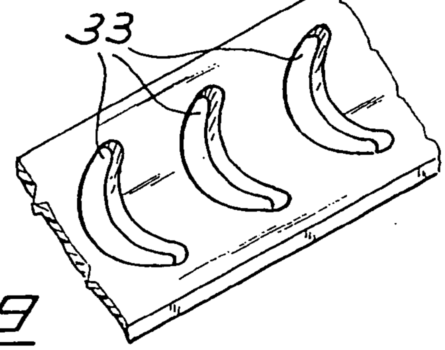


Fig. 9

Fig.10

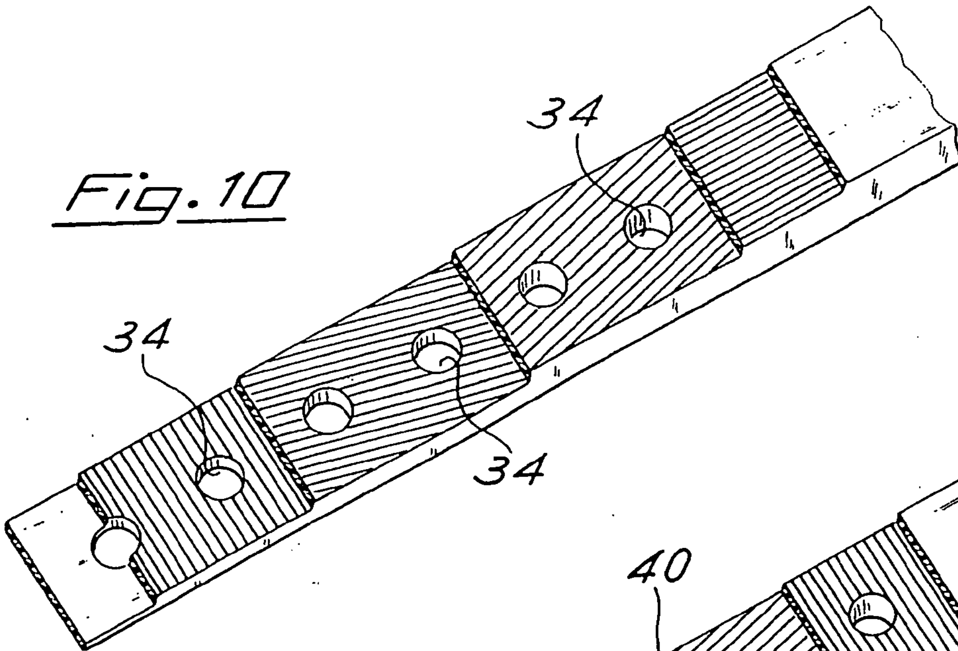


Fig.12

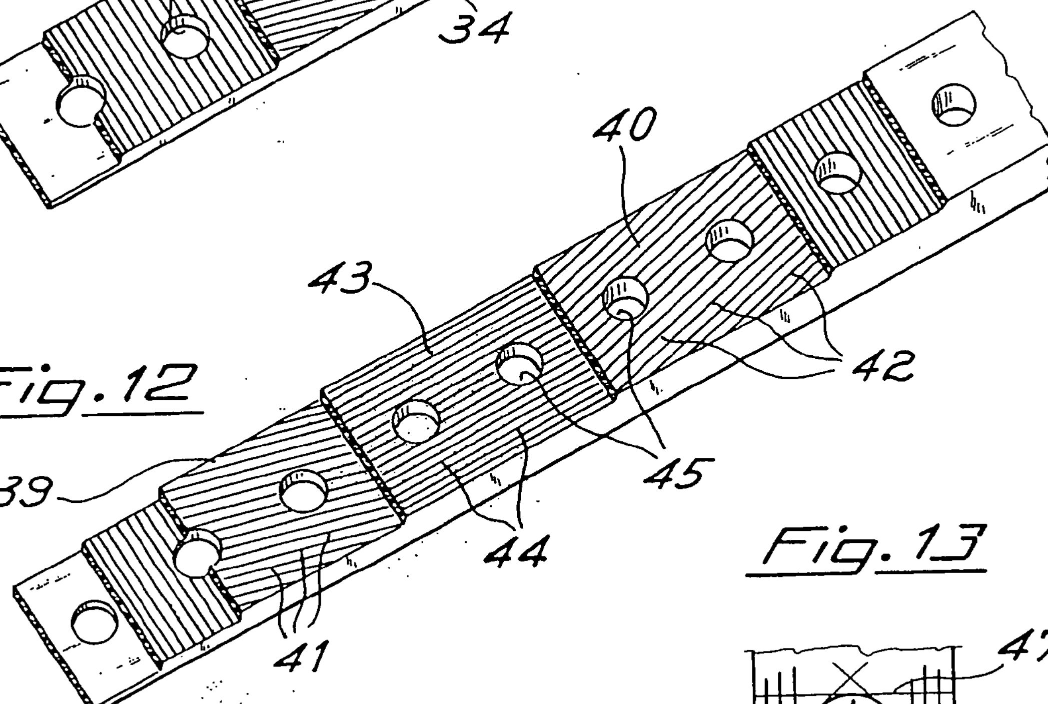


Fig.13

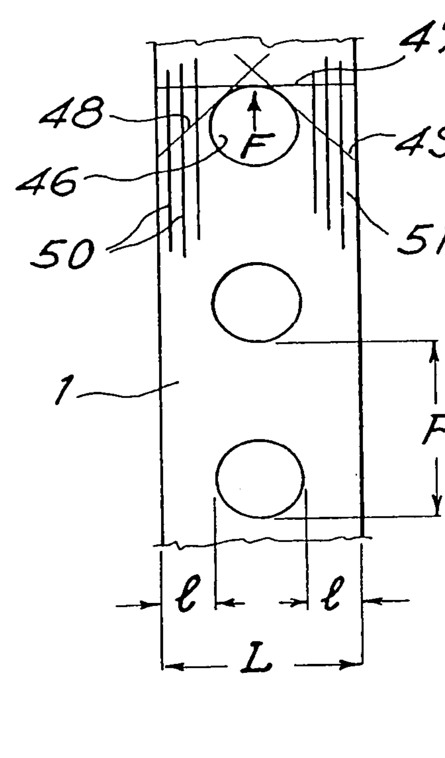
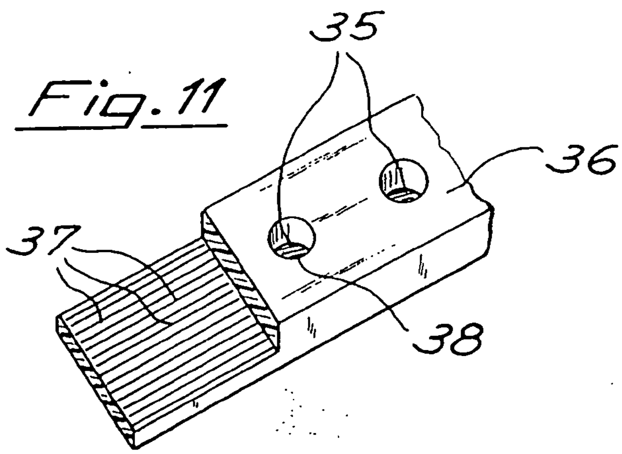


Fig.11



SPECIFICATION
Driving Belt

This invention relates to a driving belt.

As is known, driving belts which include a body of an elastomeric material are essentially of three types and are identified (according to shape) as flat belts, V-belts and toothed belts. Each type of belt has its own field of application. In particular, flat belts have the characteristic of being very flexible so that they can be used with a high ratio of transmission; unfortunately, said belts, transmitting power to the pulleys through friction, have performances limited by the forces of friction and obviously they have not any synchronous motion. On the other hand, V-belts, when compared with flat belts, offer the advantage of being able to transmit higher power by virtue of the wedging action of the flanks of the belt between the respective faces of the pulleys which increases the efficiency or quality of engagement; moreover, such belts are of reduced cross-sectional area compared with flat belts. However, V-belts are less suitable than flat belts for high speeds and, owing to their greater thickness, they give rise to greater losses of power both because of the bending deformations and because of the transverse compressions which they undergo as they travel around the pulleys.

Toothed belts, besides having the property of providing a synchronous drive, transmit power through the teeth of elastomeric material which project from the annular body and which engage with the corresponding spaces between the teeth of the pulleys, therefore, said belts are not dependent upon friction for their effectiveness as are the belts previously discussed. However, in some circumstances, and especially under stresses, the skipping phenomenon could occur, namely, the skipping of a belt tooth with respect to (out of) the respective space of the pulley(s), with consequent loss of drive transmission and with consequent unacceptable drawbacks. Therefore, with the use of these belts, it is necessary to apply between the two pulleys a tensioning force sufficient to prevent such skipping but said tension must be rather high in order to guarantee the compensation for the relaxations and wear of the structure in the course of time. Further, in some applications, there is rather a noticeable noise level with such belts, and, moreover, it is to be noted that the weight of the toothed belts can cause critical vibrations at speeds which are not high. A drawback common to all belts of synchronous type is the precision with which the pulleys must be aligned in order to avoid ruptures and in order to prevent them from coming out of their seats. In the case of belts having toothing on both faces, those skilled in the art know very well the difficulties of manufacture and the criticity of operation.

Several improvements have been made in drive belts of the types discussed above; however, limits have been reached beyond which it is apparently very difficult to go and it does not seem possible to increase further the friction coefficient between the flat belts and the pulleys, or to increase considerably the wedging action of the V-belts between the angled faces of the pulleys, or to go beyond particular elastomeric compounds for the teeth of the toothed belts.

But, whilst admitting that it is possible to overcome all the present difficulties, it does not seem possible to confer on a single belt all of the advantages offered by the conventional belts.

Therefore the present invention aims at providing a belt for the transmission of drive between two pulleys which is able to solve all at once all of the cited drawbacks, and which is further very flexible and lightweight, which is subjected during movement thereof around said pulleys to very low heating of the elastomeric material, and which is substantially indeformable and therefore able to guarantee proper or accurate drive transmission.

Accordingly, the present invention consists in a driving belt for transmitting the motion between two pulleys, comprising an annular body of elastomeric material, said belt being characterized by the fact of comprising a flat-shaped annular body reinforced with continuous and flexible elongated elements, resistant to traction, directed in the longitudinal direction of the belt, at least a plurality of openings formed in said annular body aligned in the longitudinal direction of the belt to engage with corresponding protuberances on the pulleys, each said opening engaging partially the width of said belt, said annular body being provided with reinforcing elements directed in parallel to one another in a first direction inclined with respect to the longitudinal direction of the belt and further reinforcing elements directed in parallel to one another in a second direction inclined with respect to the longitudinal direction of the belt in a substantially symmetrical way with respect to the first direction.

Therefore, drive transmission takes place in consequence of the engaging of the openings provided on the belt with the corresponding protuberances or teeth of a corresponding shape which are provided on the two pulleys and which form part of the transmission.

The stresses transmitted (for instance, by the driving pulley to the belt) are determined in the contact of the protuberances of the pulleys against the portions of the contours of the corresponding openings where said protuberances are inserted.

Said stresses do not modify the geometry of the contours of the openings because the reinforcing elements inclined with respect to one another constitute a real indeformable reinforcing structure closely arranged around said contours; because said reinforcing elements inclined to one another define or provide in the annular body resistance to tension in two distinct directions and because said elements can be suitably inclined with respect to the longitudinally extending ones, the stresses are directly transmitted by the contours of the opening to the

longitudinally extending continuous elements forming a real anchoring system apt to absorb completely all the stress transmitted by the pulleys on the openings of the belt.

As is known, in a driving belt according to the present invention, all of the elastomeric material of the belt in the whole annular body only has the function of supporting the whole reinforcing structure; this is contrary to what happens, for instance, in toothed belts where a good part of the elastomeric material (and specifically said material in the teeth projecting from the annular body) has the essential function of participating in the operation of engaging the metallic teeth of the pulleys.

Consequently, drive belts according to the present invention, in assigning only to the reinforcing structure formed by said reinforcing elements the task of absorbing the interaction stresses between belt and pulleys during drive transmission, protect all the elastomeric material from cyclically occurring stresses, thereby in practice eliminating or at least drastically reducing heating of the annular body of the belt and providing a longer service lifetime of the belt.

Further, a drive belt according to the invention is characterised by its high flexibility, in fact, the whole reinforcing structure is made up substantially of elements in the form of continuous cords which extend longitudinally of the belt, or in the form of cords or discontinuous fibers which extend in two directions which are inclined to each other and to the longitudinal direction of the belt. Said elements are reinforcing elements having usually reduced transverse dimensions and this has the result that the annular body of the belt whose function it is to support said reinforcements have a reduced cross-sectional area substantially equal to that of flat belts.

However, the flexibility of a drive belt according to the present invention is still higher than that of a corresponding or like flat belt because the belt is devoid of material in correspondence of the openings apt to engage with the teeth of the pulleys making part of the transmission. Owing to said high flexibility, the belt can easily conform to the curved outer surface which stems from the radius of the pulleys with which it will be associated.

Obviously, also, light weight is a characteristic which is still more marked in the belt according to the invention than in all the other belts discussed in the preamble and this leads, in turn, to a considerable reduction of vibration and also to virtual noiselessness of the whole drive transmission.

Further, a drive belt according to the invention can be used for transmitting any amount of power because it is not bound, as in the cases of flat and V-belts, by the limits of the friction coefficients and by the wedging action which was mentioned earlier. In fact, with a drive belt according to the invention, the transmission of power is effected as in toothed belts or in chains, namely, on the basis of a meshing, in this case between the openings formed in the annular body of the belt and the teeth arranged on the pulleys. The values of power which can be transmitted are linked to the resistance capacity of the reinforcing structure embedded in the annular body and i.e. to the particular resistance of the elements arranged along two directions with angles of inclination specially indicated later on in the present specification.

A drive belt according to the present invention, although having a synchronous operation, namely, without any sliding with respect to the pulleys, differs clearly and advantageously both from the toothed belts and from the chains. In fact, compared with the known toothed belts, the present belt has the advantage of the lack of the polygonal effect in its contact with the pulleys and of having a substantially indeformable structure, practically operating without any pretensioning and also with minimal alignment of the pulleys. Compared with the known chains, the present belt has the advantage of providing a transmission which is suitable to operate at high speed and even with pulsating loads which is completely devoid of the noise typical both of chains and of toothed belts and which does not need any recourse to a lubricating operation.

Some embodiments of a drive belt according to the present invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 shows, in a lateral perspective view, a first embodiment of a belt associated with the relative pulleys making part of the transmission;

Figure 2 shows in a perspective view the disposition of the reinforcing structure in a portion of the elastomeric body of the belt, with parts broken away;

Figure 3 shows in a partial longitudinal section, a portion of the belt engaged with its associated driving pulley;

Figures 4, 5, 6 show three other and different embodiments of the reinforcing structure embedded in the annular body of the belt;

Figure 7 shows, in perspective view, a further embodiment of the belt having openings which are arranged in two or more parallel rows;

Figures 8 and 9 show, in perspective view, different shapes which can be given to the openings provided in the annular body of the belt;

Figures 10, 11, 12 show further alternative embodiments of the belt in perspective views with parts broken away; and

Figure 13 shows in a top view some particulars of the belt with parts broken away.

By way of general example, Figure 1 comprises a driving belt 1 associated with two pulleys 2, 3 which are, respectively, driving and driven pulleys.

The belt 1 comprises (Figure 2) an annular body 4 which is of flat cross-sectional shape and which is made of elastomeric or like material in which is embedded a reinforcing structure 5 and a plurality of openings 6. Each opening 6 extends right through the thickness of the annular body

and is adapted to engage a corresponding protuberance 7 of the respective pulley as shown in Figure 3.

The material forming the annular body could be, in one embodiment, of polyurethane type.

In the present specification, the word "opening" means any perforation which extends completely through or only partially through the thickness of the body 4, said perforation having any desired contour, such for instance as circular, elliptical or even non-curvilinear profile. Said openings occupy part of the width of the belt and are delimited by the elastomeric material, possibly both longitudinally and transversely of the belt. The term "protuberances", as used herein, is intended to mean any radially projecting parts on the periphery of the respective pulley, each said part obviously having a shape which is complementary to that of the opening in the drive belt or which is of a shape suitable for engagement of said opening. Protuberances will sometimes be called teeth in the following description.

Reference will now be made to an annular body 4 comprising a plurality of substantially circular openings 6 aligned with one another longitudinally of the belt and in mid-width position therein (Figure 2).

The reinforcing structure 5 is embedded in the elastomeric or other material of the body 4, said material having, for instance, in some applications a thickness of 4—5 mm. Said structure 5 comprises a first layer 8 provided with a plurality of flexible continuous elongate elements 9 which are resistant to traction, which are laid parallel to one another and which extend longitudinally of the belt. At least two further layers 10, 11 are provided which have reinforcing elements 12, 13, respectively, which are arranged parallel to one another in each layer and the cords in one of the layers being laid in a direction which crosses that of the cords in the other layer. The reinforcing elements 12, 13 are symmetrically inclined with respect to the median line of the belt with an angle less than 50°; preferably, said angle falls within the range from 10° to 45°. In some particular embodiments of drive belt, said angle falls within the sub-range from 15° to 35°. The elements 12, 13 are flexible continuous elongate elements which are resistant to traction.

The expression "flexible continuous elongate elements" means elements in the form of cords or also of monofilaments substantially inextensible, of various materials, for instance textile material or also elements in the form of thin metallic wires; in particular, there are included in this definition glass fibers, aramide polyamide fibers more specifically known under the Registered Trade Mark Kevlar, polyester fibers, nylon fibers or fibers of various textile materials as usually used in known driving belts, or felted materials with high orientation.

In particular applications in which it is desired to transmit high power, the reinforcing structure 5 can also comprise a further layer 14 of elastomeric or other material provided with said flexible continuous elongate elements 15 which are resistant to traction and which extend transversely of the belt; a sheet of elastomeric material 16 can be further placed on the layer 14.

At the surface of the belt which, in use of the belt, is to be in contact with the pulleys (and possibly also all around the opposite face) the belt can comprise an anti-abrasive covering which is usually in the form of a fabric. Preferably, said anti-abrasive covering comprises two fabrics doubled together with the interposition of a layer of elastomeric material; the outermost fabric could be a self-lubricating fabric as disclosed in United Kingdom Patent Specification No. 1,245,204. In one example, said fabrics are rubberized nylon fabrics.

In one alternative to that which is mentioned above, the anti-abrasive covering instead of being a fabric could be realized by using compounds felted for instance, with polyester, nylon or also Kevlar (Registered Trade Mark) and the like.

In particular, the disposition of said covering on the opposite faces of the belt permits (when making the perforations on the annular body 4 to obtain the openings 6) the introduction of small fringes or thin strips of said fabrics into each opening in order thus to cover or line the inner wall of the opening. In this way, the disengagement or release of each tooth of the pulley from the respective opening of the belt is facilitated concomitantly with the reduction or the elimination of all wear phenomena (on the walls of the openings) which are usually caused by the teeth disengaging the belt.

According to a possible embodiment, the belt comprises flexible continuous elongate elements which are resistant to traction and which are arranged on a plane which bisects the annular body into two portions of equal thickness and which extend longitudinally of the belt. In positions substantially symmetrical with respect to said central plane there are disposed all the further layers represented in Figure 2. This embodiment is such as to enable both the faces of the belt to engage corresponding pulleys which form part of the transmission. In this embodiment, the openings of the belt have a wider section at each of the belt faces and a smaller section at said plane; in this way, the light compression condition to which the innermost layer of the belt is subjected when said belt is wound around the pulley and the consequent small reduction in the cross-sectional area of the opening which is at said belt face which is in contact with the pulley is compensated by the greater starting dimension of the section of the opening; the section of the opening which is on the mid-thickness plane of the belt does not change its contour because said plane is arranged on the neutral axis of the belt resistant section. With this embodiment, it is possible to obtain a condition of near-perfect engaging between the openings of the belt and the teeth of the pulley.

In a further alternative embodiment shown in Figure 4, the belt comprises a structure whose layers 17, 18 have cords 19, 20 which are laid in directions which cross each other. Said layers 17, 18 are placed side by side (edge to edge) and not as shown in Figure 2 in which the layers 10 and 11 are superimposed (face to face). In this case, these particular cords of the resistant structure could be said to take a herring-bone layout for the reinforcement around each opening 6.

According to further realizations the structure 5 can comprise more than one pair of layers of cords laid in directions which cross one another; for instance, two pairs of layers whose angles of inclination with respect to the longitudinal direction of the belt are equal, or a first pair of layers comprising cords crossed and inclined at 35° with respect to the longitudinal direction of the belt and a second pair of layers comprising cords crossed and inclined at 45° with respect to the longitudinal direction of the belt.

Figure 5 shows a belt whose longitudinal elements 21 are arranged only at each side of the openings 6; also, in this case, the reinforcing structure placed around the openings 6 corresponds to that represented in Figures 2 and 4. In fact, the elements 21 constitute the system to which the part of the reinforcement which is arranged around the openings is anchored.

The belt shown in Figure 6 is similar to that shown in Figure 2 comprising an elastomeric annular body 4 in which is embedded a resistant structure. Thus, there is a first layer 22 having longitudinally extending cords 23 and a layer 24 having transversely extending cords or reinforcing elements 25. However, the intermediate layers 26, 27 comprise, as reinforcing elements in the two layers, a plurality of discontinuous fibers 28, 29 indicated with dashed line, oriented in the elastomeric or other compound in such a way as to have become directed along two main directions which are inclined to each other in the same way as explained above for the cords 12 and 13 of Figure 2. These discontinuous fibers are of limited length and can be of mineral type (for instance glass fiber) or of textile material (for instance, according to a preferred embodiment, of Kevlar fibers embedded and suitably directed in a compound of elastomeric material. In some applications, said Kevlar fibers can have lengths which fall within the range from 2 to 15 mm, and a diameter of around 0.1 mm. The percentage weight of the fibers with respect to the total weight of the compound forming each layer 26, 27 could fall within the range from 5% to 20%.

The modulus of traction of said discontinuous fibers is the same as that of the steel. Preferably, the elastomeric compound is based on neoprene rubber and each layer is prepared according to known techniques in conformity with which a mixture comprising fibers dispersed therein is transformed, by extruding or by calender operation, into a flat shape in which the Kevlar fibers are oriented parallel to the greater direction of the profile, subsequently cut in known manner to form layers with fibers extending in the desired direction.

The belt of Figure 6 is equivalent to that of Figure 2 but is distinguished from it by its greater rigidity derived from the layer having Kevlar fibers.

Figure 7 shows a belt completely equal to the belt of Figure 2 except for the difference of comprising a plurality of openings 30, 31 arranged in two parallel rows, preferably offset from one another (not transversely aligned) as shown in the Figure. The belt of Figure 7 can be favourably used, with advantage, to engage pulleys comprising teeth which are disposed in parallel rows and offset from one another, when transmissions of high power is needed; said rows can be for instance two or more.

According to a general principle, said openings disposed in parallel rows must be arranged in such a way as to leave longitudinally between one row of openings and the other (or another) a continuous space or body portion which is devoid of any kind of interruptions, said space being necessary for the incorporated continuous reinforcing elements extending longitudinally of the belt.

According to further embodiments, the openings in the belt could have contours different in plan configuration from circular; for instance, Figure 8 represents a belt characterized by having openings 32 each with an oval-shaped contour; such an opening therefore, is very extended transversely of the belt to reduce the specific pressure due to the engaging of the pulley tooth with the belt opening. Further, the contour of the opening extending completely through the annular body could be still very extended transversely of the belt with a substantially semi-circular or banana shape as shown in Figure 9 and indicated by the reference number 33; this shape is usable, however, only when the belt is moved in only one running direction.

Up to now the various realizations of the belt according to the invention have been shown with holes or openings extending completely through the thickness of the belt.

However, a drive belt according to the present invention includes all embodiments in which there are non-through or blind openings which can be formed with means which are provided with small milling cutters or which can be formed by means of appropriate moulding appliances. Thus, for instance in the case of a belt adapted to engage on both of its faces, the openings could be extended from each face up to the aforementioned plane which bisects the annular body into two portions of equal thickness, and in practice the bottom or blind end of each opening is delimited by said cord layer which is on said plane and in which there are disposed the longitudinal elements. Said openings could extend into the belt up to the reinforcing layer which is nearer the belt face without reaching any reinforcing element.

Still referring to said alternative embodiments, Figure 10 represents a belt which is the equal to

any shown in the preceding Figures with the difference that the openings 34 are not through-openings, as can be noted by observing not only the layer provided with longitudinally extending cords but also the outer covering placed on that face which is opposite to the pulley-engaging, said outer covering being provided with anti-abrasive fabric too.

Figure 11 represents a belt comprising openings 35 provided in the face 36 which is adapted to go into contact with the pulley; as shown, said openings are not through-openings and even at their blind ends they do not reach the longitudinally extending cords 37 and the cords 38 inclined with respect to the longitudinal direction (median line) of the belt.

Figure 12 represents a belt substantially similar to that which has been described up to now with the difference that the reinforcing layers 39, 40 having cords 41, 42 symmetrically inclined with respect to said median line are respectively in contact with the opposite faces of the layer 43 in which the cords 44 extend longitudinally of the belt. The belt comprises further layers having cords which extend transversely of the belt and which are in contact with the covering layers as clearly shown in the Figure. The openings 45, instead of being through-openings as represented in the Figure, could be non-through-openings such as are indicated in Figures 10 and 11.

In one embodiment, the belt is characterized by a reinforcing structure comprising further continuous longitudinally extending elements and, as elements inclined with respect to the median line or longitudinal direction, cords or filaments of a fabric. The fabric of threads having the same resistance in weft and warp (for instance having cotton, polyester or Kevlat cords) is cut according to known techniques at angles of about 45° with respect to the warp direction. Then, said fabric is so laid as to form, during use of the belt, a plurality of lozenges whose sides have substantially the above specified directions inclined with respect to the longitudinal direction of the belt. Of course, the layers of fabric could be more than one in order to increase the resistance capacity of the whole belt. Preferably, the fabric is a rubberized fabric or a fabric impregnated with liquid or solution rubber.

In all of the above-described embodiments some preferred characteristics of geometrical sizes of the belt have been found. As shown in Figure 13, if the distance between two successive belt openings is indicated with P and if the diameter of each opening of the belt is indicated with D, said distance P can be linked to the diameter D according to the following range of values:—

$$P = \text{from } 1.25D \text{ to } 2.5D$$

This relationship is valid also in the case of an opening having a contour different from circular, it being intended to indicate in this case with D the maximum dimension of the opening measured in the direction longitudinally of the belt. In particular, the longitudinally continuous lateral portions of the belt in respect of the openings have a width l, referred to the total width L, comprised in the following range of values:—

$$l = \text{from } 0.1L \text{ to } 0.40L.$$

The behaviour of the drive belt according to the present invention under stresses during the transmission of motion will now be described:—

In this situation, the segment of belt shown in Figure 13 is stretched between driving pulley and driven pulley; in fact, the openings of the belt portions (not shown) which are actually in engagement with the teeth of the driving and driven pulleys put the inextensible longitudinal cords into traction whilst leaving the openings disposed in central position in the belt with a substantially unchanged configuration. Supposing that the opening 46 is subjected to the resulting thrust F transmitted by a pulley tooth, said stress will be transmitted, by way of the transverse cord(s) 47, to the cords 48, 49 which, in turn, will unload the whole stress in equal parts onto the longitudinally extending cords 50, 51. The transmission of the stress from the cords 48, 49 whose directions of lay cross each other to the longitudinal cords 50, 51 is complete and immediate because all of the cords are practically directly in contact with one another and are mutually bound or connected to one another by the cross-linking of the elastomeric or other material in which said cords are embedded.

In the transmission of the stress from the walls of the openings to the longitudinal cords, there is transmission of transverse components of modest value but these are such as not to alter substantially the parallelism of the longitudinal cords. Said characteristic derives from the choice, previously described, of the angles of inclination of the cords whose directions of lay cross each other in the two adjacent layers of the reinforcing structures of the belt. Consequently, deformations of the proper contours (plan configurations) of the belt openings are avoided and, because the openings which are not yet engaging the pulley teeth remain with unchanged configurations, at the right moment they carry out correct and gradual engagement of the teeth of the pulleys.

The belt has the advantage of being manufactured on an industrial scale utilizing equipments already known in the technique, mainly a building-up drum and a vulcanizer. The building-up drum has a cylindrical shape, is of collapsible type and has a wideness sufficient for manufacturing a number of or various belts at one and the same time. On the building-up drum, when it is put into rotation, there are gradually wound the various strips shown in and described with reference to the Figures of the accompanying drawings in order to form a cylindrical sleeve which is subsequently cut with appropriate knives arranged in planes which are perpendicular to the rotational axis of the drum; in

this way the cylindrical sleeve formed on the drum is divided into a plurality of belts placed side by side.

Vulcanization or cure can take place for instance by introducing the building-up drum into suitable tanks or containers in which there is placed a flexible covering or membrane pushed against or somehow applied to the outer surfaces of the belts to guarantee a uniform and sufficient moulding pressure during vulcanization/cure. In the vulcanized product, there are made the perforations necessary for forming the openings through or in the annular body of each belt. As an alternative to that just described, the openings through or in the belt could be made according to processes for moulding the elastomeric material of the belt around a central core, internal to the mould and comprising suitable projections suitable to provide the desired contour of the openings.

The described belts owing to the characteristics of high flexibility and light weight have numerous advantages; in fact the presence of textile cords or Kevlar discontinuous fibers enables the belt body to adapt to any sudden deviation from the proper alignment of the pulley shafts making part of the transmission as a consequence for example of jerks when the belt constitutes one of the components of a motor-vehicle.

In practice, a drive belt according to the present invention has a flexional rigidity practically negligible in the direction longitudinally of the belt. This characteristic depends not only on the particular use of flexible elements, generally textile cords, but also on the width of the openings obtained in the annular body; in other words, besides the importance of choosing the optimum elastomeric or other materials which obviously help to determine a very high flexibility and light weight, the alternating of openings and empty (i.e. free from openings) spaces contributes to the great flexibility.

In consequence of the above-mentioned characteristics of high flexibility and light weight, the belts according to the invention can be adapted to any desired run between pulleys having shafts disposed in any way whatsoever. In particular, thanks to the characteristic of being so light, the belts according to the invention are practically devoid of high intensity mechanical vibrations.

The light weight is still more important in those driving belts according to the present invention which are intended to operate on both faces. The advantage becomes evident when one remembers that conventional toothed belts have considerable masses carried by both faces (namely, the teeth projecting from the annular body) which are greater than those of the present belt.

A further advantage resultant from the form of drive belts according to the invention resides in the easier and more economic formation of the belts described herein by comparison with the manufacture of toothed belts which are adapted to engage on both faces. In fact, in the conventional "bi-toothed" belts it is possible, for some applications, to meet with problems in providing exact alignment of the upper and lower teeth during the manufacturing process. On the contrary, in drive belts of the present invention, the formation of through-openings automatically ensures precise alignment between the parts on both faces of the belt which are intended to engage pulley teeth.

Then, there are facilitated for clear reasons (in particular because of the flat shape of the belt) the lacing operations; therefore, there is favoured the manufacture of said types of belts, also on a plane, with lengths which are not limited.

In the present description, the word "textile" used to describe materials or threads or cords has the meaning conventionally attributed to it in the tyre industry and comprises, by way of example, organic materials such for example as cotton and rayon, and fibres from synthetic polymers, such for example as polyamide fibres and polyester fibres.

CLAIMS

1. A drive belt for transmitting motion between two pulleys and comprising an annular body of elastomeric or other material, said annular body being flat and being reinforced with flexible continuous elongate elements which are resistant to traction and which extend longitudinally of the belt, openings in said annular body which are aligned in the longitudinally extending direction of the belt in order to engage corresponding protuberances on the pulleys, each of said openings extending across part of the width of said belt, said annular body being provided with reinforcing elements which are laid parallel to one another in a first direction inclined with respect to the longitudinal direction (median line) of the belt and also being provided with further reinforcing elements which are laid parallel to one another in a second direction inclined with respect to the longitudinal direction (median line) of the belt, the first and second inclined directions being substantially symmetrical with respect to said median line.

2. A belt as claimed in Claim 1, wherein said openings are through-openings.

3. A belt as claimed in Claim 1 or Claim 2, wherein said reinforcing elements extending in said first and second directions are symmetrically inclined with respect to said median line of the belt at angles which fall within the range from 10° to 50°.

4. A belt as claimed in any one of the preceding Claims, wherein said reinforcing elements are flexible elongate elements in the form of cords, filaments or the like.

5. A belt as claimed in any of Claims 1 to 3, wherein said reinforcing elements are in the form of discontinuous fibers oriented along the said respective first and second inclined directions.

6. A belt as claimed in any one of Claims 3 to

5, wherein said reinforcing elements are disposed in two layers with the reinforcing elements of the respective layers being symmetrically inclined with respect to said median line.

7. A belt as claimed in any one of the preceding Claims, which further includes flexible elongate elements which are resistant to traction and which are embedded in the material of said annular body and which extend transversely of the belt.

8. A belt as claimed in any one of the preceding Claims, wherein some of said flexible elongate elements resistant to traction are arranged on a plane which bisects the thickness of the belt into equal portions, further layers having reinforcing elements being disposed in positions which are substantially symmetrical with respect to said plane.

9. A belt as claimed in any one of the preceding Claims, which further includes an anti-abrasive covering on that surface of said annular body which is intended to be in contact with said pulleys, parts ot said anti-abrasive covering extending into and lining said openings.

10. A belt as claimed in any one of the preceding Claims, wherein said openings are arranged one after the other on parallel rows, said rows being separated from one another by a continuous longitudinally extending zone which is devoid of any kind of interruption, and flexible continuous longitudinally extending elements being disposed in said zone.

11. A belt as claimed in Claim 1, wherein a fabric of threads having the same resistance in weft and warp is stretched longitudinally of the belt, the reinforcing elements provided by said warp and weft threads of the fabric being directed substantially along said first and second directions.

12. A drive belt for transmitting motion between two pulleys, said belt being constructed, arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated in any of the Figures of the accompanying diagrammatic drawings.

13. A drive transmission comprising a belt and pulleys, wherein the belt is as claimed in any one of the preceding Claims and wherein the pulleys have protuberances for engaging said openings of the belt.

14. Any features of novelty, taken singly or in combination, of the embodiments of the invention hereinbefore described with reference to the Figures of the accompanying diagrammatic drawings.

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